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ABSTRACT

This paper discusses the implications of using a problem-centered, activity-based approach to teaching technology that addresses everyday teaching and learning problems. An overview of the course, "Technology for Teachers," is provided, and the following factors that contribute to the teaching method are outlined: creating a context for learning; teaching in the way people learn; learners entering the classroom with a variety of experience; a different view of technology; and a desire to create a "hands-on, minds-on" environment for learning technology. The theoretical foundations underlying this open-ended learning environment are also discussed. Participants, goals, objectives, course implementation and requirements are presented; and the benefits, problems, and issues of teaching in this type of learning environment are discussed in relation to the learner and the instructor. (Contains 20 references.) (AEF)

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Technology for Teachers: A Case Study in Problem-Centered, Activity-Based Learning

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Introduction

Traditionally, technology classes have been taught in lock-step fashion, moving from technology to technology, emphasizing mastery of specific skills. While this method has proven effective -- at least in relation to short-term use of the technologies -- we were interested in creating a different learning environment for teaching technology to teachers. In redesigning the course, we employed a problem-centered, activity-based approach where technologies are "anchored" in authentic and familiar problems in which teaching and learning occurs. This approach is one based on the view of an open learning environment where the learners have direct input for the direction of the course. It is a problem-centered, activity-based approach to teaching various technologies to address everyday teaching and learning problems.

Teaching the technology in this manner creates a new learning environment, with different requirements and expectations not only for the learner, but for the instructor as well. In this paper, the implications of teaching a course in this manner will be discussed. An overview of the course will be provided, including the theoretical foundations underlying the learning environment. Participants, goals and objectives, as well as requirements of the course will be presented. Discussion of moving theory into practice in the actual implementation of the course will be explored. Promises, problems and issues in relation to teaching in this type of learning environment will be discussed, both in relation to the learner and the instructor.

Background

Technology for Teachers, first offered in the spring of 1994, is focused on creating the conditions under which people typically work to understand everyday things: first developing a need to learn, then satisfying the need. We work to create "needs to know" by referencing issues for which the learner has already acquired significant expertise, and examining how technology can help the learner address these issues. Several factors contributed to the way the course is currently taught. These include: a desire to create a context for learning, wanting to teach the way people learn, learners entering the classroom with a variety of experience, a different view of "technology" and a desire to create a "hands-on, minds-on" environment for learning technology.

Creating a Context for Learning

The educational community has seen an influx of technology into the classroom. However, the technology growth has not been paralleled in use and integration of technology into the everyday classroom experience (Carr, Novak, & Berger, 1992; Glenn, 1993; Handler, 1993; Ingram, 1992). Educators continue to fall behind the technology curve, with adoption resistance a predominant theme. While researchers working in teacher education have noted potential causes, ranging from lack of modeling to lack of skill, a fundamental component in the lack of adoption appears to be the lack of a mental model for integration of the technology.

In working toward integration, we moved away from a primary focus of technology skills to one of technology integration. To create this atmosphere, the course centers around creating a context for learning. The participants gain experience in the educational uses of "things" such as computers, interactive video and electronic communication; the experience is gained by applying use of the technology to practical problems encountered in everyday teaching. The technology is not presented as **the** solution, but rather **a** solution -- a way to make processes and tasks easier for the teacher, learner, and parents.

Teaching in the Way People Learn

In addition to creating a context for learning, we were also guided by a desire to teach the way people learn: developing a need to know, then satisfying the need. The course centers around problems and issues encountered in the everyday classroom. The participants work toward solving the problems, taking into account multiple points of view and using a variety of technologies. The course focuses on empowerment of the learner: they create their own goals and define the problems they want to solve.

Different Levels of Experience

The participants in the course are primarily Pre-K to 12 teachers. While the learners share a common interest in education, their experiences with technology are quite diverse. Some enter the classroom with little to no experience; others with considerable experience in many of the technologies discussed in the course. This left us with the challenge of accommodating a variety of experiences, working to keep one group from feeling overwhelmed and the other from becoming bored.

"Technology" beyond "Things"

Another factor contributing to the way the course is designed is a broadening of the view of "technology." The course focuses on emerging visions of schooling, teaching, and learning. Included in these visions is a varied role of technology for supporting the visions. Technology is defined more broadly than "things" and "media." Technologies, in the context of the course, are defined as practical methods used to accomplish practical goals -- the organized means used to accomplish diverse ends. The course is not so much about computers as it is about using technologies in a broader sense. While some approaches to the problems presented focus on how the technology can create new ways to accomplish existing goals, others emphasize new ways to exploit roles that have traditionally been untapped.

Creating a "Hands-on, Minds-on" Environment

As in most technology courses, there is a focus on creating a "learning by doing" environment. To afford the learners with a hands-on opportunity, the course takes place in a networked lab environment utilizing Macintosh-based technologies. It is an ideal setting for learning the technologies: having several technology tools readily accessible makes it easy to demonstrate ideas, present information, tap into telecommunications capabilities, and naturally integrate technology into the activities of the course.

The lab is also used to enhance a "minds-on" environment. The learners are presented with a variety of technologies, as well as a learning environment where exploration, inquiry, and discovery are modeled and encouraged. Use of the network is an integral part of the course. From the first class meeting, learners are exploring the network, discovering where tools for the course are located and feeling their way around the new environment.

In addition to the factors leading us to design *Technology for Teachers* in the way it is currently taught, there is an underlying theoretical foundation: open-ended learning. The theory and its principle assumptions will be discussed in the next section.

Theoretical Foundation: Open-Ended Learning Environment

Interest in "unleashing" the capabilities of technologies to create learning systems that differ from traditional directed instruction has recently grown. In addition to the interest in integrating technology, we also wanted to create a learning context couched in the principles of open-ended learning environments (OELEs). The factors influencing the design of *Technology for Teachers* made this type of learning environment a viable solution for meeting the requirements.

Despite the growth in interest in technology-based learning environments, we were not generating a new learning environment free from controversy. Considerable disagreement exists related to the viability of open-ended learning and the systems that reportedly facilitate it. Advocates point to benefits such as increased flexibility and utility (Spiro & Jengh, 1990; Spiro & Feltovich, 1991), and improved individualization of knowledge, as evidence for the promise of technology in user-centered learning (Cognition and Technology Group at Vanderbilt, 1991). Skeptics, on the other hand, question what is actually learned via open-ended systems suggesting that effectiveness claims may prove impossible to validate (Dick, 1991). The challenge remains for bridging the divergent views on the topic.

Defining Open-Ended Learning Environments

A significant problem in this debate has been the vagueness with which open-ended learning and open-ended learning environments (OELEs) have been characterized. Contributing to the vagueness is a lack of common definition or understanding of open-ended learning and OELEs. Perhaps the best way to understand open-ended learning is to contrast it with directed learning. Directed learning involves the systematic acquisition and retention of externally-defined knowledge and skills. An individual is a successful directed learner when he or she is able to utilize the strategies and features provided by the instructor to acquire prescribed knowledge and skills to acceptable levels.

Open-ended leaning refers to processes wherein the intents and purposes of the individual are uniquely established and pursued. It involves the individual determination of what is to be learned, how it is to be learned, when (or if) learning goals have been met, and what (if any) subsequent steps might be taken. Any number of things might be candidates for individual learning; the intents and goals of different learner would likely vary substantially. In effect, the fundamental difference between directed and open-ended learning is in who determines what is to be learned and what steps are taken to promote learning, including the resources consulted, both internal and external, during the learning process.

Cognitive Principles Underlying OELEs

The assumptions of open-ended learning are not merely cosmetically or semantically different from assumptions of traditional instruction, but are fundamental shifts in how the learner, knowledge, and the structure of the environment are conceptualized. While significant variations among open-ended learning environments are apparent, they also share several common assumptions which are manifested either explicitly or implicitly within the environment. Several critical assumptions and accompanying beliefs, adapted from previous research (Hannafin, Hall, Land, Hill, 1994), can be identified.

Context and experience are critical to understanding. Open-ended learning environments view the processes of learning and the context in which it occurs as inextricably tied. Open-ended environments embed learning activities in authentic contexts -- as concrete instances reflecting problems to be solved -- in order to foster thinking that originates from personal and practical experiences (Roth & Roychoudhury, 1993).

Understanding is individually mediated. In open-ended learning environments, the learner judges what, when, and how learning will occur -- beliefs influenced heavily by constructivists who emphasize the importance of constructing personal meaning (Guba, 1990). Self-directed learning requires the learner to assume individual responsibility for the learning process: asking relevant questions, pursuing needed knowledge, evaluating learning experiences, and so forth. Learning, in this manner, is thought to be less passive, less compliant, and less dependent on external direction than learning from traditional instruction (McCaslin & Good, 1992). The challenge comes in determining how best to support and guide these highly individualized processes without imposing unnecessary, potentially conflicting, external structures.

Cultivating cognitive processes is often more critical than generating learning products. Open-ended environments are designed to support higher-order cognitive skills such as identifying and manipulating variables, interpreting data, hypothesizing and experimenting (Roth & Roychoudhury, 1993). Their open-ended nature reduces the emphasis from specific content and rule-based knowledge in favor of self-reflections and thought-based action. This focus requires learners to use cognitive and metacognitive strategies extensively. Perkins (1993) refers to the notion of "executive function" in describing the self-directed process of making decision, monitoring thinking, and constructing understanding. Open-ended environments provide opportunities for learners to attend to things they perceive as relevant, decide for themselves and evaluate their own thinking.

Understanding is more vital than knowing. Much of the criticism surrounding traditional instruction is that it often stresses recalling information rather than understanding complexities (Spiro, et. al., 1991). Open-ended learning environments immerse learners in experiences that foster understanding through extended exploration, manipulation and opportunities to "get to know" an idea, rather than simply being told about it (Papert, 1993). Interactions emphasize the underlying reasons "why" an idea or concept exists instead of simply acknowledging or accepting its validity. Understanding is augmented by personal experiences, points of view, and cognitive scaffolding.

Qualitatively different learning processes require qualitatively different methods. The goal of many open-ended learning environments is to immerse learners in rich, cognitively-complex experiences by providing various tools, resources, and activities with which to think. OELEs focus on problem-solving skills in authentic contexts, affording opportunities for exploration and theory building (Schwartz & Yerushalmy, 1987), and providing multiple -- sometimes complimentary, sometimes competing -- perspectives (Language Development and Hypermedia Research Group, 1992). Gagne (1985) was instrumental in acknowledging that varied types of learning require differential instructional goals and activities. Gagne and Merrill (1990) noted that conceptually complex learning goals are often difficult to achieve with traditional instructional approaches. Multiple context, purposes, resources and representations of knowledge may be necessary in order for learners to engage in complex and ill-structured learning (Spiro, et al, 1991).

Guided by the theoretical foundations of OELEs, as well as the factors motivating us to seek a new way to approach teaching technology, *Technology for Teachers* was created. Unlike other applications involving OELE principles, such as the *Jasper* series at Vanderbilt (Cognition and Technology Group at Vanderbilt, 1992) and *Intermedia* at Brown University (Yankelovich, et al, 1988), *Technology for Teachers* is based in real-time, involving the continuous interactions of humans. Specifics of this implementation are discussed in the next section.

The educational climate, in combination with the externally defined requirements and our interests, made the design of *Technology for Teachers* as an OELE possible. Components of the course will be discussed in the following sections. This includes a general overview, participants, goals and objectives, course requirements, and grading procedures.

Course Overview

Technology for Teachers attempts to create the conditions under which people typically work to understand things: developing a need to learn, then satisfying the need. The course operates under several important premises. First, within educational settings, technologies are not so much a curriculum as sets of tools to be put to use productively. The course works to establish what those productive uses might be.

Another premise is that productive use is influenced by three factors: context, audience, and activity. Problems presented for solution in the course are anchored in everyday classroom teaching and learning problems for which various technologies can be employed for, and with, learners, teachers, and communities. The goal is not to become an expert in technology, but to become more of an expert in teaching and learning.

Finally, the course operates under the assumption that teaching specific technologies will only enable the learner to accomplish a task in the short term. Technological advances continue to move forward at an exponential rate; present applications will inevitably be replaced by "new best ways." In moving the learner to a point of long-term usage and adoption, developing problem solving and cognitive strategies for the use of technology are highlighted.

Participants

The students enrolled in the course are diverse. Students taking the course represent various backgrounds, both in their professional interests as well as their technology expertise. The course not only attracts pre-service teachers; it also draws its population from a variety of disciplines across campus: accounting, communications, leisure services, and library science. The diversity of the classroom is also substantiated by the fact that it is a cross-level course, including both undergraduates and graduates.

Technology experience is just as variable as the professional interests of the students. Most students enter the course with a moderate level of technology experience; however, there are students that fall on the far ends of the experience continuum. A few students have never touched a computer and have typical fears of the technology; others have extensive experience, but need the credit in order to meet accreditation regulations (Technology for Teachers Surveys, 1994).

Goals/Objectives

The primary goal of the course is not to create experts in technology, but to assist the learners in increasing their levels of expertise in teaching and learning with the thoughtful application of technology. The problems presented in the course are anchored in classroom teaching and learning; problems for which various technologies can be employed for, and with, learners, teachers, and parents. Significant focus is given to the learner's individual growth as they work on various activities to solve common educational problems.

Specific objectives for the course include:

- To identify problems for which varied technologies offers useful alternatives for teachers, learners, and parents
- To plan and develop alternatives, featuring varied technologies for varied target audiences
- To develop a personal/professional growth plan for gaining facility in the uses of varied technologies
- To promote personal/professional growth by increasing both the range of technology alternatives and the ability to address problems with them

Components, Tools, and Techniques

There are several components to the course, both in terms of the tools and techniques used in the course and what is required from the learners. Each of these are discussed in the following section.

Tools. From the outset of the course, the learners are provided with tools to assist them in working in the learning environment. In addition to a syllabus, the learners receive a project documentation tool, a portfolio assessment methods tool, and a portfolio growth scale. A textbook is also used in the course: Lockard, Abrams, and Many's book, *Microcomputers for Twenty-First Century Educators* (1994,

3rd ed.). The text is not used in lock-step fashion; rather, it, like the other resources made available to the learner, is used as a supplement to what is occurring in the context of the classroom setting.

Accessing information. Establishing procedures for accessing information is a fundamental component of the course. "Accessing information" is defined in a broad sense. The network is used extensively to access the tools, as well as other documents that are loaded to clarify or explain technologies being discussed in class. The learners are encouraged to use electronic mail to communicate, both with each other and with us. Learners are also encouraged to seek information from each other, as well as other resources (such as the lab assistants, or their school media specialist) beyond the instructors.

Problem-centered, activity-based. Another technique used in the course is the introduction of technologies through problems. The course addresses problems and issues encountered in an educational context. Learners are encouraged to consider ways technology can be used to address the problems and issues. Throughout the semester, the students are presented with problems and issues to consider in relation to solving educational problems. While a focus is placed on solving those problems and issues with technological interventions, the learner is encouraged to expand their views.

Overtime, it is expected that the students in the course will begin to re-frame the problems and to consider alternative approaches and methods for defining the teaching-learning partnership. For example, the set of problems presented to the learners in a unit on telecommunications is: "How can my kids communicate with kids from other cultures or countries?; How can I find the latest information on a unit I will be teaching next week?; and How can parents find out information about the academic calendar or other school events?" This approach to viewing problems from multiple perspectives takes place with all of the technologies introduced in the course.

Demonstrations and practice. Following the establishment of a problem-centered context for learning, technologies are demonstrated to the class. This takes the form of "mind food:" it is a time in the class session when we present different ways to use the technologies. We demonstrate a variety of things that can be done, centered in different problems.

Learners next "walk-through" a hands-on process with us. This usually takes the form of a step-by-step demonstration. Practice time in the class is also provided. Several activities are demonstrated and practiced with each technology. This gives the learners the opportunity to experience a variety of ways to use the technology, thus helping to expand their views of how to incorporate the technology into their learning environments.

Requirements

Learners solve problems both as members of groups and/or as individuals. Three unit projects are being used: two occur throughout the semester; a final project is due at the end of the course. The unit projects are designed to integrate the technologies in a logical fashion. The first project integrates word processing and databases. The second project integrates telecommunications, desktops publishing and graphics.

The final unit covered in the course deals with emerging technologies, including videodisks, interactive video, and multimedia applications. The final project is geared toward the learners using these technologies. They are also allowed to create an integrated project reflecting all of the technologies covered throughout the semester.

All of the projects are turned in and graded in a portfolio format. We make use of the network and have a mechanism in place that enables the learners to turn in all of the work to us in electronic form. The electronic portfolios are evaluated after each project and feedback is provided to the learners.

Presentations of the work that is being completed occurs throughout the course. This includes demonstrations of completed work, as well as works in progress. Use of presentations also exposes the learners to presentation technologies, including LCD panels and demonstration programs like PowerPoint.

A final requirement of the learners is a reflection paper. This paper is due at the end of the course and is designed to encourage the learners to look back on their progress in the course, reflecting on what they did and where they would like to go next. The paper also addresses feedback on the course itself. Learners are encouraged to be critical and give suggestions for improvement.

Theory into Practice: Promises and Problems

Teaching technology in an OELE brings with it several promises and problems. Surveys from the three courses taught last year illustrate both the positives and negatives associated with OELEs -- at least from the perspective of the learner. Each of these, as well as our perspectives and unresolved issues, is discussed below.

Promises

Teaching technology in an OELE is a challenging, and in retrospect, very rewarding task. Not only did we see the classes as a whole develop in their technology skills, but significant strides in individual growth was encountered as well. Examples include: all learners reported an increase in the use of technologies; while over 50% of the participants said they started out feeling confused about the technology, all were in the high comfort zone by the end of the course; and the majority of the students reported that they liked to work individually and be assessed by individual growth (Technology for Teachers Surveys, 1994).

Direct statements from the learners can attest to the positive results of teaching technology in an OELE:

- I am leaving this class with not only a great deal of knowledge about computers and their possibilities than I had, I think I most importantly am leaving with confidence in myself when it comes to computers with[out] the intimidation that can hold anyone back from venturing and learning.
- My life's philosophy is if you can find the resource, then you can solve the problem. Working with computers is an ongoing process; everytime I sit down in front of one, I learn something different.
- I believe that the most valuable thing I learned from this class, however, was how to overcome my fear of making mistakes....I learned to trust myself a little bit more and to not feel as threatened by new technological development.
- I am not as intimidated by computers as I used to be and I believe I can do anything on the Mac now that I have a basic understanding....The main thing, though, is that not only can I do a lot more things with computers, but my fear of using computers is gone.
- I have learned to look around and ask around for what technological resources are available.... I assumed that if technology wasn't blatantly there in front of me, that it wasn't there.
- The most beneficial part of this call to me attitudinal. I am more enthusiastic about learning new technologies rather than fearing them. Another beneficial aspect of the course was the ability to tailor the technology applications to something relevant to us as individuals. Learning through experimentation and hands-on exposure proved very effective.

These statements from the learners in *Technology for Teachers* clearly reflect their enthusiasm for the course, the techniques and methodologies that were used, and the benefits the learners felt they received in learning in this environment. Getting to this point, however, was a long and often painful process, both for the learner and us. These factors are discussed next.

Problems and Issues

Perhaps the biggest problem facing all of the participants in the course was the time factor in relation to how long it took the learners and us to become comfortable. All of the participants in the course are accustomed to working and learning in a very directive and highly structured learning environment. *Technology for Teachers* is anything but directive and highly structured. In fact, one of the criticisms raised by the students is that it lacked detail and specifics. "One of the major problems I had with this course [was] that everything seems rushed and I was not comfortable with anything I turned in because of the pressure to complete my project on time" (Technology for Teachers Reflection Papers, 1994).

We also encountered experiences of disorientation and disorganization. Teaching in an OELE is quite a different experience from teaching in a more directive environment. The challenge for the instructor is one of how best to support and guide processes that are highly individualized without imposing unnecessary, potentially conflicting, external structures. Adapting to the demands of these learning environments, getting past the initial bump, is an issue, both for the learner and the instructor.

Closely tied to these feelings of discomfort over the learning environment is grade stress. This is well documented by one student when he states, "I think another reason it was tough [the course] is that the format is very free so a person doesn't know what qualifies as "A" work" (Technology for Teachers Reflection Papers, 1994). Grade stress had an effect on several aspects of the course, including resistance to the learning environment and identification of growth by the students -- their primary focus was on the "A," or lack thereof. Helping learners to overcome this stress, enabling them to move into an assessment realm of growth continues to be an issue to be resolved.

The variety of experience levels in the course is another issue that must be resolved. While several benefits were gained from having a variety of experience levels in the course, including sharing of ideas among peers and peer-tutoring, learners reported that varying levels of experience was distracting and that they worried about holding back the class or, in turn, being held back by the class (Technology for Teachers Surveys, 1994). One learner voiced her concern in the form of a question: "...wondering how you could separate the class from beginners, intermediate and expert.... How does one balance a class like this???" (Technology for Teachers Reflection Papers, 1994). We continue to seek the best answer to this query.

Technology for Teachers is a learning environment founded on the principles and assumptions of open-ended learning environments. Initial strides in creating a context for learning based on this theoretical foundation have proven successful; however, much work remains to be done to overcome the problems and issues associated with these environments. Continued work and research in these environments is critical if they are to continue to expand and grow. It is only though this continued work that educators can hope to reach the ultimate goal: creating learners rich in cognitive and problem-solving strategies.

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